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4. SOURCE ANALYSIS

This section identifies and evaluates potential and actual soluble organic matter sources to the dissolved oxygen impairment in the New River, including tributary drains. Sources are in two categories: human-made and natural. Soluble organic matter sources can negatively impact water quality and the aquatic organisms in the New River (Setmire, 1984).

A. METHODOLOGY

Estimating pollutant source contributions for dissolved oxygen and soluble organic matter impairment is significantly different than performing the same analysis for other pollutants such as sediment, pesticides, or nutrients. Dissolved oxygen and soluble organic matter loadings are measured as a concentration (i.e., milligram of oxygen per litre of water). Other pollutants such as sediment, pesticides, and nutrients are generally expressed as mass-based measurements (i.e., pounds per day). Dissolved oxygen and soluble organic matter source measurements reveal the concentration at any given point in time[1], not the amount of soluble organic matter a discharger "produces." A mass-based organic matter measurement would be misleading because a discharger typically contributes not only soluble organic matter to a waterbody, but also organic material which are not readily available for microbial decomposition.

Soluble organic matter is rapidly decomposed by bacteria and other organisms in the New River (Setmire, 1984). A time lag occurs before bacteria begin utilizing discharged organic matter for respiration. The amount of organic matter and dissolved oxygen begins to decrease in conjunction with an exponential increase in bacteria. After a period of time, the bacteria reach their peak growth attributable to the original discharge (which may have occurred several miles upstream). When the last of the organic matter is consumed, the bacteria eventually die off and dissolved oxygen increases or recovers.

The New River situation is much more complex because: (a) multiple discharge points occur along the River, and (b) soluble organic matter sources from upstream cumulatively affect dissolved oxygen concentrations downstream. For example, a bacteria population (consumers of oxygen) at the International Boundary may be dying off, until discharges from a U.S. wastewater treatment plant adds organic matter to the New River, allowing the bacteria population to grow. A dissolved oxygen measurement taken downstream of this plant would likely show a lower dissolved oxygen concentration than it would have without

[1] It is possible to calculate the soluble organic matter impairment discharged into the New River, based on the total volume of wastewater discharged by each source. However, this would have little regulatory significance because dissolved oxygen and biochemical oxygen demand WQOs are expressed as concentrations.

the 'leftover' organic matter from Mexico. Therefore, measuring dissolved oxygen concentrations upstream and downstream of a discharge point without considering the river system as a whole may attribute contributions to the wrong source. For this reason, a qualitative description of the river system helps to quantify the various source contributions for the purpose of the Source Analysis Section of this document.

This source analysis shows that raw sewage from Mexico is the primary soluble organic matter source causing the dissolved oxygen impairment in the New River. National Pollutant Discharge Elimination System (NPDES) facilities, natural sources (wildlife and wind deposition), farmland and urban runoff are relatively insignificant soluble organic matter sources. An analysis of each source is described below.

A.1 POINT SOURCES IN THE U.S.

A.1.1 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) WASTEWATER TREATMENT PLANTS

Nine facilities currently discharge pollutants into the New River pursuant to the National Pollutant Discharge System (NPDES) program. Eight of these NPDES facilities are wastewater treatment plants (WWTPs) discharging domestic wastewater. The other NPDES facility is the Second Imperial Geothermal Company (SIGC), which is permitted to discharge 0.8 mg/d of cooling tower blow-down water indirectly into the New River via the Beech Drain. This facility is not considered to be a source of soluble organic matter requiring further evaluation. The eight WWTPs discharge secondarily treated domestic wastewater and have largely been in compliance with their effluent limits. Table 4.1, below, lists the NPDES facilities, along with their flows, discharge locations, BOD and DO effluent concentrations for the last three years. The eight WWTPs DO effluent concentrations are at or above the Water Quality Objectives (Table 2.1 and 2.2) and BOD effluent concentrations are at or below the Water Quality Objectives. Therefore, they are not considered a significant source of soluble organic matter to the New River.

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Table 4.1 Domestic NPDES WWTPs Discharging Wastewater into New River

Discharger	Approx. Avg. Flow (mgd)	Discharge Location	Discharger[2] Classification	Effluent BOD (mg/L)	Effluent DO (mg/L)
U.S. Navy Facility, El Centro	0.11	New River, about 1000 feet upstream of Worthington Road Bridge	Minor		
City of Calexico, 298 East Anza Road, Calexico	3.0	New River, about 1.5 miles downstream of the International Boundary	Major		
Centinela State Prison, 2302 Brown Road, Imperial	0.6	Dixie Drain 1-C, which flows about 6 miles before it discharges into the New River	Minor		
City of Westmorland, 5295 Martin Road, Westmorland	0.16	Trifolium Drain No. 6, at a point 3.6 miles upstream of where the Trifolium Drain discharges into the New River	Minor		
Seeley County Water District, 1898 West Main Street, Seeley	0.13	New River, about 1500 feet downstream of Evan Hewes Road Bridge	Minor		
City of Brawley, 400 Main Street, Brawley	3.15	New River, at a point 47 miles north of the International Boundary.	Major		
Date Gardens Mobile Home Park, 1020 W. Evan Hewes Hwy., El Centro	0.01	Rice 3 Drain, at a point 7 miles upstream of where the Rice 3 Drain discharges into the New River	Minor		
McCabe Union School District, 701 West McCabe Rd., El Centro	0.0015	Wildcat Drain, at a point 3 miles upstream of where the Wildcat Drain discharges into the Rice 3 Drain. Following the junction of the Wildcat Drain with the Rice 3 Drain, the Rice 3 Drain flows for another 7 miles before it discharges into the New River	Minor		

[2] Classification based on volume of flow discharged and USEPA Guidelines.

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A.1.2 Confined Animal Feeding Operations (CAFOs)

Confined Animal Feeding Operations (CAFOs) are defined as "any place where cattle, calves, sheep, swine, horses, mules, goats, fowl, or other domestic animals are corralled, penned, tethered, or otherwise enclosed or held and where feeding is by means other than grazing" (California Code of Regulations Title 27). Nine CAFOs exist within the U.S. portion of the New River watershed. These CAFOs are regulated by Board Order No. 01-800 (General NPDES Permit and General Waste Discharge Requirements for Confined Animal Feeding Operations). CAFO facilities are listed in Table 4.2, below.

Table 4.2 Confined Animal Feeding Operations in the New River Watershed

Site, Address, and Map Reference Number	Maximum Number of Animals Confined	Distance to the New River or a tributary	Soluble Organic Matter Threat to New River[3]
Brandenburg Feed Yard 903 West Highway 98, Calexico, 1	4,000	Adjacent to Greeson Drain	Moderate
New River Cattle 420 West Kubler Road, Calexico, 2	10,000	Adjacent to New River	High
Phillips Cattle Co. 910 Nichols Road, El Centro, 3	15,000	Adjacent to New River	High
Meloland Cattle Co. 907 Brockman Road, El Centro, 4	16,000	Adjacent to Wisteria Drain	Moderate
Jackson Feedlot 495 West Heber Road, El Centro, 5	15,000	1.5 miles	Low
El Toro Land and Cattle Co. 96 East Fawcett Road, Heber, 6	16,000	2 miles	Low
Kuhn Farms Dairy 1870 Jeffery Road, El Centro, 7	10,000	Adjacent to Dixie Drain #4	Moderate
Cameiro Heifer Ranch 195 West Corey Road, Brawley, 8	8,000	2 miles	Low
Ruegger and Ruegger Feedlot 604 Bannister Road, Westmorland, 9	2,500	Adjacent to Timothy Drain	Moderate

The significance of these specific CAFO facilities on New River soluble organic matter sources is currently unknown. CAFOs are known organic matter sources to surface water and groundwater (Nishida, 2001). Possible contamination routes include groundwater infiltration /conveyance, and transport by stormwater runoff. Infiltration and conveyance seem more likely in the Imperial Valley because of the low amount of precipitation. The CAFO facilities, see table 4.2, have retention basins for run off storage designed to contain 24 hours in a 25 year storm. In addition all CAFO facilities have berms to prevent run off. Imperial Valley's arid climate, low rainfall, and very fine-grained soils diminish

[3] Threat estimates are based on site's size and proximity to surface water.

CAFO potential to significantly impact receiving waters. The contribution from CAFOs to the New River soluble organic matter is considered to be insignificant relative to other sources from the U.S. and Mexico.

A.2 NON-POINT SOURCES IN THE U.S.

A.2.1 AGRICULTURAL RUNOFF

The New River is sustained for the most part by agricultural return flows from the Imperial Valley and the Mexicali Valley in Mexico. Most of the agricultural flows in the Imperial Valley reach the river via agricultural drains operated and maintained by Imperial Irrigation District (IID). Flood irrigation is the typical irrigation method practiced in Imperial Valley. Water that runs over the field to the drain without percolating into the soil is called tailwater and has the potential to transport soluble organic matter to the drains.

Figure 4.1 Wheat filter strip

Tailwater potentially picks up soluble organic matter from agricultural activities such as: livestock grazing, application of dried animal manure fertilizer, and irrigation events that attract birds to insects driven from soil. The implementation of the New River Siltation/Sedimentation TMDL and associated management practices will significantly decrease the transport of soluble organic matter to the drains. Figure 4.1shows an effective wheat filter strip which produces agricultural tailwater with lower total suspended solids and soluble organic matter. In addition, the contribution from agricultural runoff is believed to be insignificant relative to other sources from the U.S. and Mexico.

A.2.2 STORMWATER RUNOFF

Stormwater runoff is a product of intense storm events, and has the capacity to cause large-scale erosion in vulnerable areas. Most stormwater runoff draining into the New River comes from farmland, roads, and communities. The actual soluble organic matter contribution from the stormwater runoff of these entities is unknown. However, intense storm events are uncommon, as the area has an annual average precipitation of about 2.5 inches. Stormwater runoff from the Imperial Valley area accounted for less than 0.8% of the New River's flow in 1994 through 1999 (California Regional Water Quality Control Board 2000).

Most runoff percolates into the ground, evaporates, or is discharged into WWTPs. It has been found that the amount of pollutants entering the stormwater system is rainfall dependent but does not necessarily depend on the source (Walker and Wong, December 1999). Stormwater runoff is not a significant soluble organic matter source, unless the stormwater comes in contact with animal manure fertilizer.

A.2.3 URBAN RUNOFF

Urban runoff is non-stormwater runoff originating from human urban activities, such as landscape irrigation and car washing. Urban runoff drains into tributaries or a river itself. Westmorland, Calexico, and the unincorporated community of Seeley do not have urban runoff collection and conveyance systemsSeveral public placeshave urban runoff collection and conveyance systems, including: (a) the Calexico Airport, which discharges directly into the New River, (b) Brawley, discharges 60% to the New River and 40% to the WWTP (Phone Conversation with WWTP Personnel 2000), and (c) El Centro Naval Air Station, discharges to the New River (Phone Conversation 2000).

Urban runoff is known to carry soluble organic matter. It is more likely to evaporate or infiltrate into the ground than to end up in the New River, due to the local arid climate and low level of urbanization. (Urbanization is present in less than 0.5% of the New River drainage area.) Therefore, the fate of urban runoff parallels that of stormwater runoff—that is, urban runoff is not a significant soluble organic matter source.

A.2.4 NATURAL SOURCES (WILDLIFE AND WIND DEPOSITION)

Natural sources of soluble organic matter include warm- and cold-blooded wildlife and wind deposition. These sources can contribute by lowering the dissolved oxygen in the New River directly and indirectly via agricultural drain water. Turtles and birds, as well as other wildlife, use farmland for sustenance, particularly farmland with grain crops. To what degree these natural sources contribute soluble organic matter to the New River is unknown, but their contribution is believed to be insignificant relative to other sources from the U.S. and Mexico. Characterizing the contribution from these sources will be extremely difficult until the high soluble organic matter at the International Boundary is significantly reduced.

A.3 KNOWN SOURCES IN MEXICALI VALLEY, MEXICO

Point and nonpoint sources from Mexicali Valley contribute to New River dissolved oxygen impairment. Point sources of soluble organic matter include: wastewater treatment lagoons, sewage collection and conveyance system, industrial discharges, and CAFOs. Nonpoint sources primarily consist of agricultural return flows and urban runoff.

Figure 4.2 Tula West Drain

Sewage service for the Mexicali metropolitan area is divided into the Mexicali I and Mexicali II service areas. Mexicali I includes most of the old, well-established neighborhoods to the west of the city's existing sewage collection and treatment system excluding the Gonzalez-Ortega lagoon system. Mexicali I uses the Zaragoza lagoon system as its wastewater treatment plant (WWTP). Mexicali II includes the new residential and industrial development areas to the east, and uses the Gonzalez-Ortega lagoon system as its WWTP. Mexicali II also has a proposed 20-mgd WWTP under construction and the wastewater is not going to be discharged in the New River or its tributaries.

The City of Mexicali is undergoing unprecedented growth. The present population of Mexicali is reported as 438,377 by Mexico, but some believe it is much greater-approaching 1 million. The population in the Mexicali area is expected to increase at 2.6% per year (INEGI 2000). Mexicali lacks an adequate sewage collection and treatment system for current and projected flows (California Regional Water Quality Control Board, 2003) (Figure 4.2). It currently is served by two systems of stabilization lagoons, both of which are equivalent to secondary systems and lack disinfection facilities. The systems have a combined design capacity of 20 to 25 mgd, but sewage flows were 35 to 40 mgd in 1997 (CH2M Hill 1997). The volume of untreated municipal wastewater bypassed from the collection system into the New River is currently estimated at 8 million gallons per day (mgd) (California Regional Water Quality Control Board, 2003) (Figure 4.3). A Mexicali II collection and treatment system with a capacity of 20 mgd is under construction to accommodate eastern Mexicali. Completion of the new treatment system is

Figure 4.3 Bypass of raw sewage into Mexicali Drain

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expected in 2005 and wastewater discharge from this facility will be rerouted away from New River Watershed. Both treatment systems regularly encounter operation difficulties. In 2000, Mexicali discharged 5 -20 mgd of raw sewage into the River daily between January and May due to major collectors being off-line. Figure 4.2 shows the Mexicali I and II service areas, key sewage infrastructure, the New River and its main tributaries in Mexicali, and key known industrial facilities discharging into the watershed.

Most of the International Boundary soluble organic matter load is related to Mexicali's inadequate sewage infrastructure (e.g., pumping plants and principal sewer lines) (Figure 4.4). 5 to 25 mgd of raw municipal sewage are discharged into the New River daily. Tables 4.3 and 4.4, list known and potential soluble organic matter sources in the Mexicali Valley. The tables are based on Regional Board and USIBWC reports on monthly observation tours of the New River watershed in Mexicali and of the main sewage infrastructure. The tables are not all-inclusive[4], but do provide a picture of the overall threat to New River water quality.

Table 4.3 Identified Mexican sources of soluble organic matter

Source	Approx. Potential Volume (mgd)	Type of Wastes			Biological Oxygen Demand
		Municipal Raw Sewage	Undisinfected Wastewater	Industrial Wastes	
Drain 134	5.0	X		X	XXXX
Pumping Plant No. 1	15.0	X			XXXX (a)
Pumping Plant No. 2	5.0-7.0	X			XXXX (a)
Pumping Plant No. 3	5.0	X			XXXX (a)
Pumping Plant No. 5	0.1-0.9	X			XXXX (a)
Mexicali II Collector	5.0	X			XXXX (a)
Nutrimex Collector	3.0	X			XXXX (a)
Gonzalez-Ortega Pumping Plant	3.0	X			XXXX (a)
Gonzalez-Ortega Lagoons (Mexicali II WWTP)	3.0		X		XXXX (a)
Solidaridad	0.9 (b)	X			
Sempra Lagoon	3.4 (b)		X	X	

[4] Observation tours indicate that a significant number of outhouses and CAFOs discharge into the New River watershed in Mexicali.

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Source	Approx. Potential Volume (mgd)	Type of Wastes			Biologica l Oxygen Demand
		Municipal Raw Sewage	Undisinfected Wastewater	Industria l Wastes	
Zaragoza Lagoons (Mexicali I WWTP)	25-35		X		XXXX (a)
Tula West Drain	6.5	X		X	XXXX
Establo Las Delicias (feedlot)	0.007 (b)	X			
San Francisco Paper Mill	0.086 (b)		X	X	
El Choropo Slaughterhouse	0.043 (b)				
Bachoco Hog and Poultry Feedlot	0.045 (b)	X	X		
Embotelladora de California (glass factory)	0.014 (b)			X	
Mi Vida Feedlot and Slaughterhouse	0.086 (b)		X	X	
Intergen Energy Power Plant	1.9 (b)		X	X	

(a) Based on CH2M Hill 1997
(b) Based on CRWQCB 2003

Table 4.4 Potential Mexican sources of soluble organic matter

Source	Approx. Potential Volume (mgd)	Type of Wastes			Biologica l Oxygen Demand
		Municipal Raw Sewage	Undisinfected Wastewater	Industria l Wastes	
Right Bank Pumping Plant (a)	1.0	X			XXXX
Maseca (b)			X	X	
Hospital Textile Systems (b)				X	

(a) Based on CH2M Hill 1997
(b) Based on CRWQCB 2003

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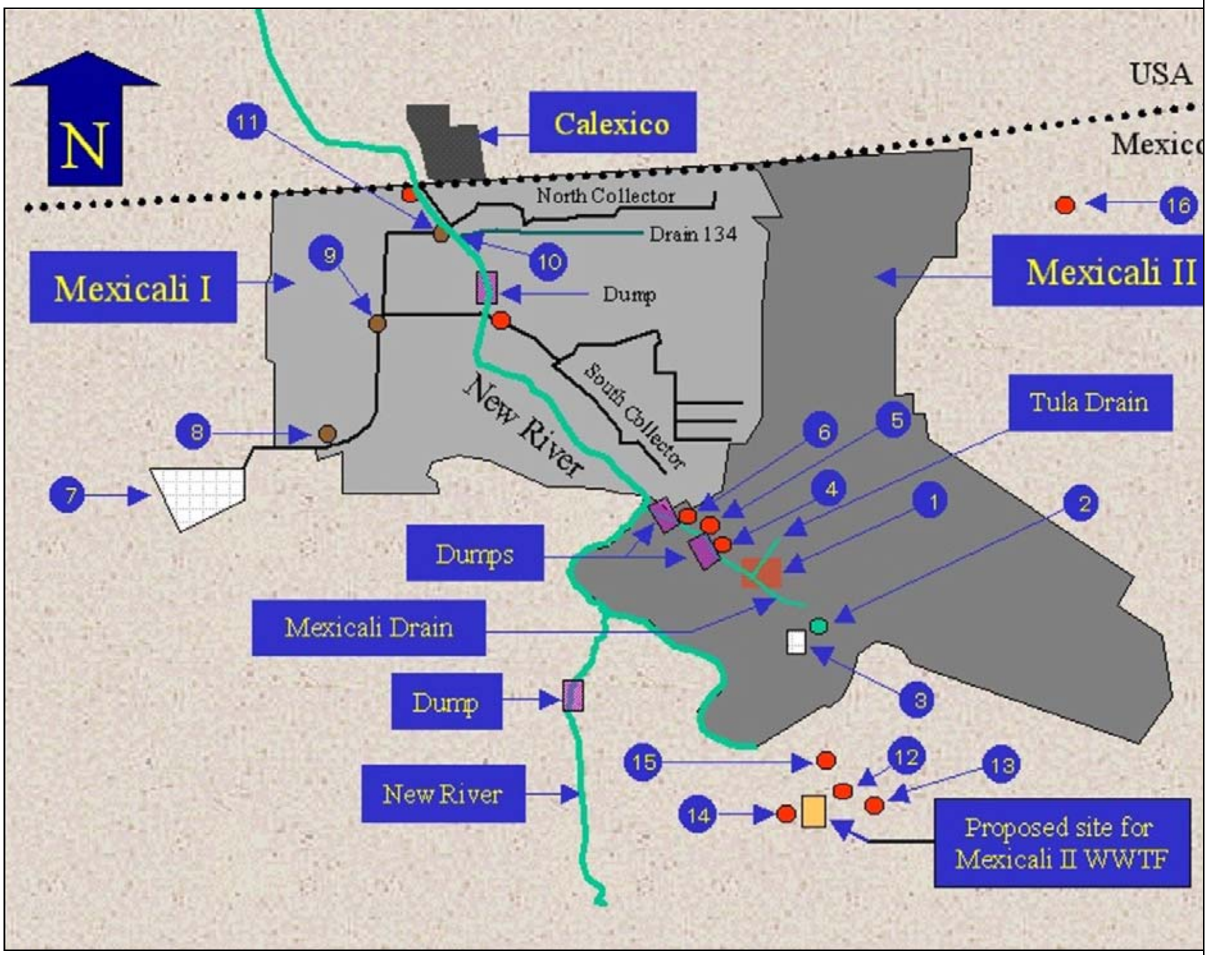
Figure 4.4 Main Sewage Infrastructure in the Mexicali Metropolitan Area



Legend: Mexicali Sewage Infrastructure Identification		
1. Industrial Area: Hidrogenadora Nacional (Conasupo), Quimica Organica, Quipac, Vitromex	7. Zaragoza Lagoons (Mexicali I WWTP)	13. Steel recycling plant
2. Gonzalez-Ortega Lift Station	8. Pumping Plant No. 3	14. Slaughterhouse discharge
3. Gonzalez-Ortega Lagoons (Mexicali II WWTP)	9. Pumping Plant No. 1	15. Maseca
4. Kenmex	10. Drain 134	16. Fabrica de Papel San Francisco
5. Collector Mexicali II bypass	11. Pumping Plant No. 2 and Right Bank Lift Station	
6. Collector Nutrimex bypass	12. Hog farm discharge	

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A.4 Recommended Activities for Refinement of Source Analysis

A continuous monitoring program is necessary at various sampling stations along the New River in Imperial Valley, in order to define the magnitude and characteristics of the low dissolved oxygen problem. Monitoring activities are included in the Implementation Plan for this TMDL, and may result in future TMDL refinement.

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